

BASS RIVER
YARMOUTH AND DENNIS, MASSACHUSETTS

SMALL BOAT NAVIGATION PROJECT
RECONNAISSANCE INVESTIGATION

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS 02254

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INTRODUCTION

This report represents the results of a preliminary engineering and economic feasibility study of navigation improvements to the Bass River at Yarmouth and Dennis, Massachusetts

Study Authority

This Reconnaissance Report was prepared and is submitted under the authority and provisions of Section 107 of the 1960 River and Harbor Act, as amended.

Study Participants

The investigation was initiated as a result of letters received from the Executive Secretaries of the towns of Yarmouth and Dennis (letters dated September 27, 1982 and October 14, 1982, respectively) requesting that the Corps of Engineers study the feasibility of Federal participation in navigation improvements to the Bass River under existing continuing authorities for small navigation projects.

Officials from both towns, recreational and commercial boat operators, and interested citizens were consulted to define the problems and needs of the study area and to provide information and data necessary to develop this report.

Prior Studies and Improvements

Federal - There have been several prior reports prepared concerning the Bass River. The first was authorized by the River and Harbor Act of 2 March 1829. It recommended a 250-foot long breakwater to provide a protected anchorage southeast of the river mouth. Construction was initiated with funds authorized on 4 July 1836 and 7 July 1838. The project was later abandoned when it was found to be unsuccessful in that the anchorage area rapidly filled with sand and a safe depth could not reasonably be maintained. Other reports concerning the need and justification for improvements, in the form of a dredged entrance channel and protective jetties, were authorized by the River and Harbor Acts of 18 August 1894 and 3 March 1899 and by a resolution of the Committee on Rivers and Harbors of the U.S. House of Representatives on 18 August 1938. These studies recommended that such improvements not be undertaken at that time.

A resolution by the Committee on Public Works of the U.S. House of Representatives on 24 June 1965 authorized the Corps of Engineers to conduct a study to determine if navigational improvements to the Bass River were needed and justified. The resulting investigation recommended that improvements, in the form of an access channel and adjacent anchorage areas, were engineeringly feasible and economically justified. However, local interests were unable to meet cost sharing requirements at that time and no further action was taken.

There are no existing Corps of Engineers' projects at Bass River because of the results of these studies. Although a Federal breakwater was constructed in 1838, it was subsequently abandoned due to the rapid shoaling of the anchorage behind it. There are Federal navigation projects in the vicinity, one at Andrews River just east of Dennis, and another at Hyannis Harbor just west of Yarmouth. Both provide recreational boating anchorages, navigation channels and jetties.

Navigation Improvements by Others - The Commonwealth of Massachusetts has made numerous navigation improvements to the Bass River.

In 1935, the State constructed an offshore jetty 2,500 feet long east of the inlet. Several years later, they built a 400-foot long jetty west of the inlet. The westerly jetty was subsequently extended about 300 feet in the mid 1950's. In 1956, the State also built a series of groins along the Yarmouth town beach, west of the river mouth, to stabilize that beach.

A channel 7 feet deep from the river mouth to the -7 foot mlw contour in Nantucket Sound was dredged in 1953 and maintained in 1958 and 1966. A 6-foot deep, 25-acre anchorage area was dredged inside the river mouth in 1953 and redredged in 1966. The 7-foot channel was extended north to the Route 28 highway bridge in 1966. Spoils from the dredging operations consisted of coarse, clean sand and was used as beach nourishment at the Yarmouth and Dennis town beaches adjacent to the river.

PROBLEM IDENTIFICATION

Existing Conditions and Problems

The Bass River forms the southerly 4 miles of the border between the towns of Yarmouth and Dennis, Barnstable County, Massachusetts. It is a small estuary which runs from several inland ponds to Nantucket Sound on the south shore of Cape Cod, 5 miles east of Hyannis and 12 miles west of Chatham. The drainage area covers 10 square miles of generally flat, sandy or marshy terrain. The river is located about 65 miles southeast of Boston, at the mid-point of the east-west arm of Cape Cod.

The area is shown on U.S. Coast and Geodetic Chart 258; U.S. Geological Survey, Yarmouth Quadrangle; and Figure 1 accompanying this report.

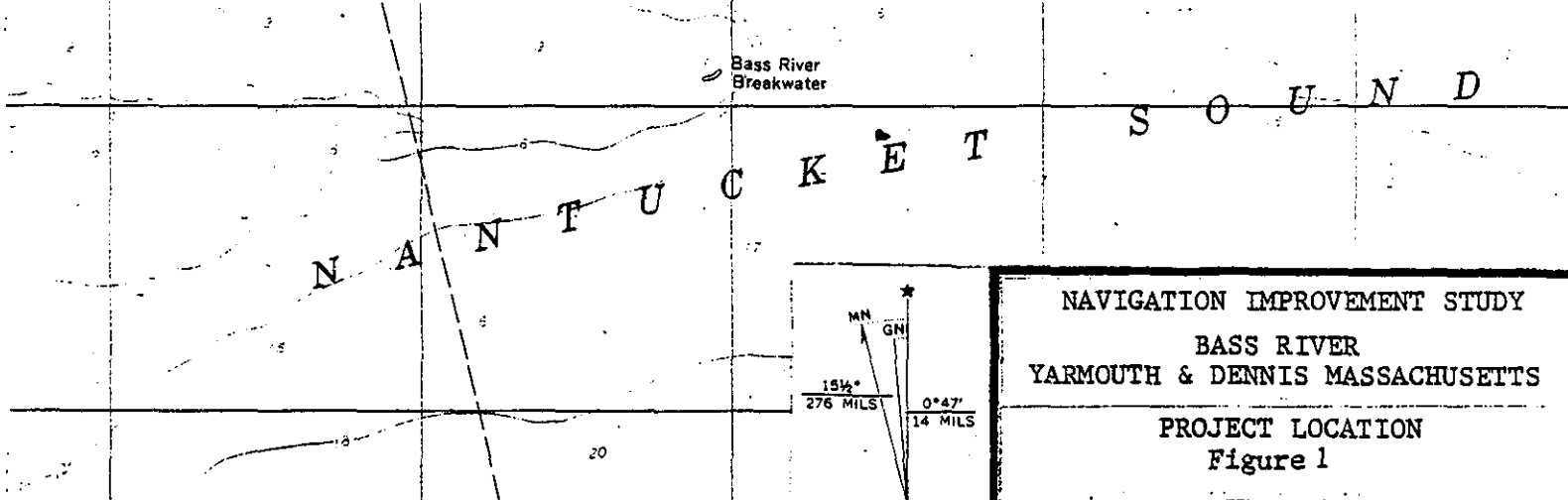
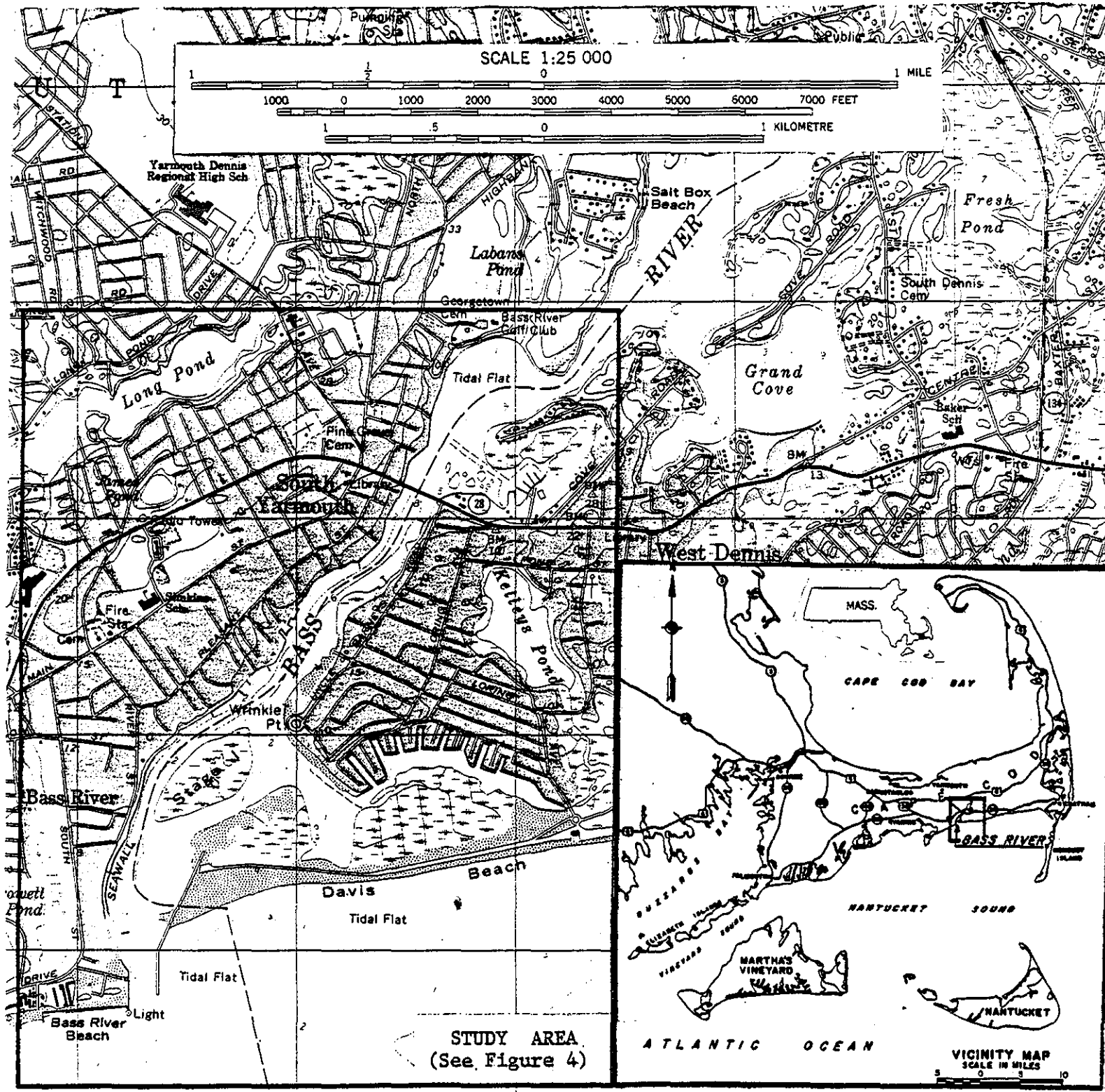
The river entrance is flanked by two jetties. There is extensive shoaling outside the river mouth and additional shoaling within the river itself from the mouth to several thousand feet north of the Route 28 highway bridge. There is a large marshy island just upstream of the mouth. To the east of this island is a narrow cove about $\frac{3}{4}$ mile long which is separated from Nantucket Sound by Davis Beach. There are four bridges spanning Bass River, one of which affects this study. It is a fixed highway bridge at State Route 28, 1.8 miles upstream from the river mouth. It has a vertical clearance of 15 feet at mean high water and a horizontal clearance of 30 feet. This limits the size of the recreational craft which can use the upstream reaches of the river. Only boats with low mast heights can proceed beyond that point. There are, however, numerous medium and small size craft located north of the bridge.

Both banks of the river are fully developed with residential housing, a few public landings, marinas, and private yacht clubs. The cove behind Davis Beach is also fully developed with residences and a yacht club.

The mean tide range is approximately 3.5 feet at the river mouth. Controlling depth in the river south of the Route 28 bridge is 6 feet at mean low water. North of the highway, it gradually reduces to 1 or 2 feet in Kellys Bay. In the offshore area in Nantucket Sound, shoaling reduces the depth to approximately 3 feet at mean low water.

Traffic consists primarily of recreational craft with a few commercial fishing vessels anchoring and landing their catch at Bass River. Anchorage areas are within the mouth of the river and are well protected from storms. Tidal currents and wave action are small.

The public roads and highways throughout Cape Cod are in good condition. Three major east-west highways service the area, providing adequate road transportation to all points on the Cape.



Bass River, along with most harbors on Cape Cod, has become crowded with recreational craft. The recreational boating boom has nearly exhausted available mooring facilities and anchorages. There are some unused areas in Bass River with water depths adequate for mooring recreational boats but they are remote from land access and are not particularly desirable. The resultant crowded conditions in the waterway restrict maneuvering space.

The principal navigation difficulty at Bass River is at the sand bars which form across the channel between 1,000 and 2,500 feet offshore. They severely reduce the depth of water and cause long tidal delays for boats using the waterway. These bars have required dredging in the past to improve navigation approaches to the river entrance.

Conditions If No Federal Action Taken

If no Federal action is taken at Bass River, the present conditions will persist and current trends will be likely to continue. Shoaling within the river will continue, further restricting available anchorage areas and reducing the already limited navigable portions of the river. Extensive shoaling in the offshore areas will result in continued tidal delays and vessel damages due to groundings.

Local interests lack the necessary capital to enable them to implement navigation improvements on their own. Without improvements to navigation in Bass River, the existing fleet will be forced to operate inefficiently and will be unable to experience any potential growth due to the physical limitations within the river.

PLAN FORMULATION AND ASSESSMENT OF A SINGLE PLAN

Excluding incremental analysis, the plan evaluated herein represents the optimum plan identified with respect to net benefits and National Economic Development (NED). Constraints such as the limited area available for expansion and the predetermined location of local improvements result in the range of possible alternatives being reduced to a single optimum plan. Future detailed analysis of this one plan would consist solely of incremental analysis with the objective of maximizing net project benefits.

Plan Formulation

As the basis for formulating an alternative plan of improvement to be evaluated, both structural and nonstructural measures were identified to address the planning objectives for improving navigation facilities for existing and prospective Bass River vessels.

Structural measures would generally involve dimensional variations of a channel and anchorage areas in the Bass River. Nonstructural measures would principally involve the determination of achieving the planning objective by other means at lower costs, such as restricting the use of the available deep-water anchorage areas to those craft requiring a deep-water anchorage (a locally implemented mooring management plan) or transferring vessels to other ports where sufficient anchorage areas are available.

The only plan involving no Federal action and no structural improvements would entail transfer of the deeper draft recreational vessels to another nearby port. This plan also calls for any potential increase in recreational boating activity in the area to be developed only at alternative ports. This is considered to be unacceptable to local needs.

Rationale and Alternatives

There are approx. 1,200 recreational and 35 commercial vessels that utilize the Bass River. Roughly 410 of these vessels are berthed at marina slips and other private facilities. The remaining 825 vessels are randomly located on one-point moorings along the course of the river. The recreational fleet is comprised of approx. 40% sail and 60% power vessels. The typical commercial vessel is an inshore vessel accomodating 1 or 2 fishermen involved with nearshore finfishing activities. As such, they require no special mooring or navigational considerations.

Based on local estimates and field inspection by Corps personnel the controlling depth in the offshore area is approx. -3 ft. at mlw. Within the river itself a natural channel exists with depths averaging -5 to -6 ft. at mlw. Some areas of the natural channel, particularly at the bends, as well as most of the available anchorage areas experience shoaling of -3

to -4 ft. at mlw. By far the most serious condition at Bass River is in the offshore area where longshore transport of sediment impedes navigation to deep water in Nantuckett Sound. This area will require special maintenance considerations.

Construction and maintenance of a navigation channel linking the boating community at Bass River with deep water in Nantuckett Sound is paramount to providing a safer and more efficient navigation project in this area. Without an established channel, fleets will continue to lose revenues due to inefficient operation and continued damages. The majority of the vessels using the Bass River have drafts of 3 to 5 feet. Since vessel speeds in the channel will be low, squat while underway will be a negligible factor in determining optimum channel depth. Wave action will also be negligible due to the well protected nature of the river mouth. Therefore, based on these considerations as well as the physical characteristics of the river bottom, it is assumed that vessels should have a one foot clearance under the keel to navigate safely. Based on these parameters, a depth of -6 ft. at mlw in the channel is considered sufficient. A 100 ft. channel width will be sufficient to accomodate the boat traffic expected to use the river.

Because of the rapid growth being experienced by the recreational boating industry, particularly on Cape Cod, there is tremendous potential for expansion of the recreational fleet at Bass River. Local officials and marina operators report lengthy waiting lists for mooring space. It has been estimated that if additional mooring space is provided the fleet would experience a straight line growth over the next 10 years of approx. 30%. With this in mind and assuming a design vessel length of 20 ft. approx. 25 acres of additional mooring space is needed to accomodate the projected fleet expansion utilizing a one-point mooring system. A 28 acre anchorage area located inside the river mouth should be sufficient to accomodate vessels currently moored in this area while providing for the anticipated fleet expansion.

The remaining areas available for dredging anchorages are to the north and east of Stage Island and north of the Rt. 28 highway bridge. However, there are several unfavorable issues associated with these areas. First, each of these areas is much more environmentally sensitive in that construction activities would require the dredging of intertidal habitats. Secondly, these areas would present increased costs of construction and maintenance due to longer transport of dredged materials to potential disposal areas. Thirdly, public access to these areas is extremely limited or, in some areas, non-existent.

A nonstructural solution would involve the transfer of existing and future vessels to other ports. This is not considered a viable alternative since all marine facilities on Cape Cod are already overburdened with vessels as a result of the large growth in the recreational boating industry.

The "no-build" option would mean the continued loss of recreational liesure time, commercial fishing time and revenues as a result of continued vessel damages and overcrowding within the confines of the Bass River.

Alternative Plan Chosen for Evaluation

In order to adequately address the problems and needs of the study area, as previously identified, an alternative preliminary plan of improvement has been developed by combining management measures which appear to be most economically feasible. The evaluated improvements are shown in Figure 2.

The first part of the plan involves providing a navigation channel which would allow for safe navigation at all tidal stages. The channel would be constructed to -6 ft. at mlw and would be 100 ft. wide to accomodate two-way traffic. The channel would start at the Rt. 28 highway bridge and continue downstream utilizing the naturally deeper portions of the river. The seaward terminus of the channel would be at the -6 ft. mlw contour in Nantucket Sound which is approx. 3000' from the light located on the outer end of the western jetty.

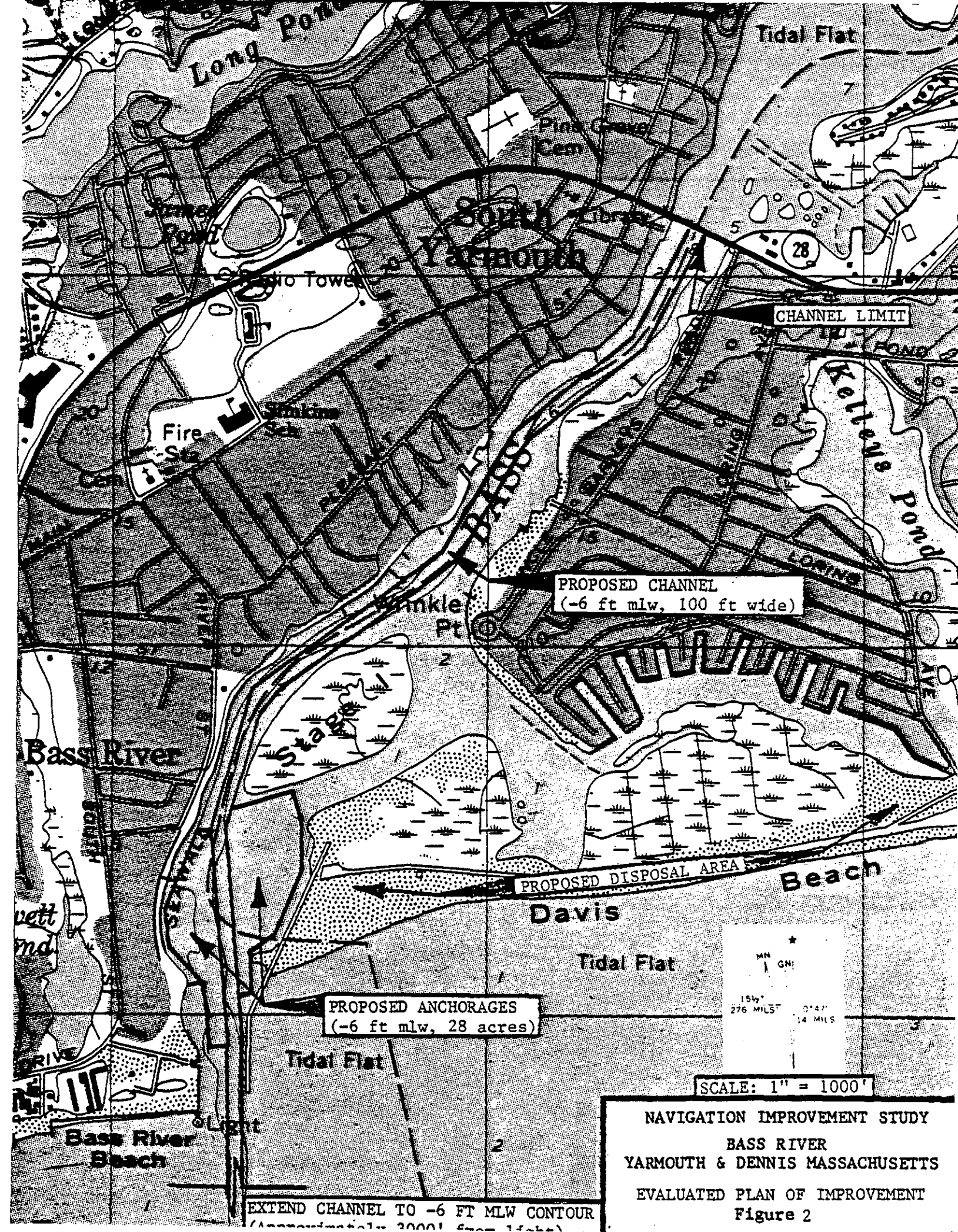
The second part of the plan would consist of providing safe and adequate anchorage to allow for expansion of the present recreational boating fleet. This would involve dredging approx. 28 acres of anchorage straddling the proposed channel just inside the river mouth. As with the channel, this anchorage would be constructed to -6 ft. at mlw.

The construction of the channel and anchorage would require removal, by hydraulic dredge, of approx. 125,000 c.y. of clean sandy material. This estimate assumes one on three side slopes and one foot of overdepth. This quantity was based on a Massachusetts Division of Waterways hydrographic survey dated 1966 and information gathered from site visits by Corps personnel.

Past dredging operations in Bass River have used the dredge material as beach nourishment on nearby beaches and it is assumed that material removed for these proposed improvements would be suitable for such uses.

Estimate of First Costs

The evaluated plan of improvement provides for dredging of a 100-foot wide access channel to -6 ft. mlw and 28 acres of anchorage area to -6 ft. mlw in the Bass River. Construction would be accomplished using a hydraulic dredge with the material deposited on beaches in the vicinity of the channel entrance. The U.S. Coast Guard would provide and maintain all aids to navigation. During the detailed study phase, specific numbers, locations, and costs for navigational aids will be obtained from the Coast Guard. Table 1 depicts the estimated first costs of construction of the evaluated plan of improvement based on Sept. 1983 price levels.



CHANNEL LIMIT

PROPOSED CHANNEL
(-6 ft mhw, 100 ft wide)

PROPOSED DISPOSAL AREA

PROPOSED ANCHORAGES
(-6 ft mhw, 28 acres)

SCALE: 1" = 1000'

NAVIGATION IMPROVEMENT STUDY
BASS RIVER
YARMOUTH & DENNIS MASSACHUSETTS
EVALUATED PLAN OF IMPROVEMENT
Figure 2

EXTEND CHANNEL TO -6 FT MLW CONTOUR
(Approximately 2000' from 1st)

TABLE 1

ESTIMATED FIRST COSTS
EVALUATED PLAN OF IMPROVEMENT

Dredging of Channel and Anchorage clean sand material 125,000 c.y. @ \$6.00/c.y.	\$750,000
Contingencies (25%)	\$187,500
SUBTOTAL	\$937,500
Engineering & Design (8%)	\$75,000
Supervision & Administration (8%)	\$75,000
TOTAL FIRST COST	\$1,087,500
Interest During Construction	\$14,500
TOTAL INVESTMENT COST	\$1,102,000

Estimate of Annual Costs

Annual charges for ammortization of the first costs of construction are based on an estimated project life of 50 years and an interest rate of 8-1/8 percent..

Two phases of maintenance dredging are assumed in estimating the annual costs associated with the evaluated plan of improvement. The first involves the offshore channel approach which experiences heavy shoaling. It is assumed that this area will experience shoaling at a rate of approximately 8,000 c.y. of material per year and will require maintenance dredging every 2 to 3 years. This material would be removed by hydraulic dredge and sidecast into Nantucket Sound.

The second phase involves the river channel and anchorages inside the jetties. The estimate for this portion of maintenance dredging is based on an assumed annual shoaling rate of 4 percent of the 100,000 c.y. originally dredged from this area, or about 4,000 c.y. annually. It is estimated that this phase of maintenance dredging will be required once every 15 years with the material removed by hydraulic dredge and placed on nearby beaches.

Maintenance of aids to navigation is the responsibility of U.S. Coast Guard and specific costs will be obtained if a detailed study is performed.

Annual charges are depicted in Table 2.

TABLE 2

ESTIMATE OF ANNUAL CHARGES..
EVALUATED PLAN OF IMPROVEMENT

Ammortization of First Costs	
\$1,102,000 x 0.08291	\$91,400
Annual Maintenance Dredging	
Offshore Bars - 8,000 cy x \$8.00/cy	\$64,000
River Channel and Anchorages - 4,000 cy x \$9.00/cy	\$36,000
TOTAL ANNUAL CHARGES	\$191,400
say	\$191,000
<u>Estimate of Benefits</u>	

Navigation improvements in the Bass River would result in significant benefits to the existing recreational fleet and commercial boat operators. Recreational benefits have been estimated on the basis of increased leisure time available to boat owners after elimination of tidal delays. Additional leisure time realized as the result of the anticipated increase in fleet size has also been estimated. Benefits to commercial vessels are based on increased finfish landings attributed to increased fishing time as a result of the elimination of tidal delays. Additional fish landings have also been estimated on the assumption that improved navigation will attract additional commercial vessels. Reduction in vessel damages has been considered for both recreational and commercial vessels. All benefits have been computed in accordance with the established policies of the Corps of Engineers.

Recreational Benefits

Recreational benefits are derived from leisure time saved through reductions in tidal delays and from reductions in vessel damages due to groundings and collisions in the channel and anchorages. For the purposes of quantifying recreational benefits resulting from improvements to the river, both increase in efficiency of navigation to the existing fleet and an increase in capacity (fleet size) have been assessed.

Benefits have been derived for the existing and future fleet based on their estimated number of days in use. It is assumed that over the 210 day recreational boating season that any given boat would be used an average of 20% of the time on weekdays and 75% of the time on weekends, or a total of 75 days per season.

As a result of the evaluated plan of improvement, leisure time would be saved through reductions in tidal delays. Maximum tidal delays over a 24 hour period were calculated for each class of boat. This delay was determined according to vessel draft plus a one foot allowance for safe

clearance under the keel. The maximum delay would occur when a vessel arrives at the shoals just as the water has fallen below the necessary clearance forcing the vessel to wait for the tide to fall to low and rise back to safe clearance again. It was then assumed that any given boat would incur 1/3 of this tidal delay, inbound and/or outbound, during an average 8 hour boating day. From this data, the number of hours saved daily and the equivalent number of boating days saved annually were calculated for each class of boat.

The average vessel drafts, necessary clearances, and tidal delay time for each class of boat are depicted in Table 3. The inventory of the recreational fleet was supplied by the town of Yarmouth and updated through site visits. Boat user estimates are based on past studies and interviews. The table shows the total number of user days saved by the proposed improvements for each class of boat.

In addition, it is estimated that the evaluated improvement could accommodate an additional 350 recreation vessels. This would represent a 30-percent increase in the size of the recreational fleet. It is assumed that 35 of the vessels would be immediate additions while the remaining vessels would be attracted over a 10 year growth period. It is reasonable to assume that these boats would be in use 75 days per year as are the existing boats. These new boats reflect the current demand and waiting lists for mooring space at Bass River as well as the trend of continued growth in recreational boating in the region. The 350 boat future fleet is expected to be the result of a 10-year period of straight line growth. Accordingly, an average annual equivalency factor of 0.71586 has been used to determine annual benefits accrued by the future fleet. Table 4 inventories the expected future fleet and estimates the total leisure time realized by these newly attracted vessels.

The three methods available for recreational benefits estimation are found in Section VIII of the WRC Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies dated March 10, 1983 and published as ER 1105-2-40 are, the travel-cost method, contingent value method, and the unit-day value (capacity) method. Because of the lack of a regional model, and the unique nature of seasonal recreational boating in New England, the unit-day value method was chosen as being the most applicable to measure increased efficiency at the study site. See Table 5 For Recreational point computation and the conversion to an equivalent unit day dollar value as prescribed by Table VIII-3-2 of the WRC Principles and Guidelines. Recreational boating is considered to be "general recreation".

TABLE 3
EXISTING RECREATIONAL FLEET INVENTORY
USER ESTIMATE AND TOTAL ANNUAL
LEISURE TIME SAVED

Type of craft	Length (ft)	# of boats in fleet	Avg. # of users/boat	Total users ¹	Avg. draft (ft)	Water Depth required ²	Tidal delay over 24 hrs.	Delay for avg. 8 hr. boating day ³	Hours foregone/season ⁴	Days foregone/season ⁵	User Days Foregone/season ⁶
Outboards	15 - 20	250	2	500	1.5	2.5	0	0	0	0	0
	21 & up	50	3	150	2.0	3.0	0	0	0	0	0
Sterndrives	15 - 20	50	2	100	1.5	2.5	0	0	0	0	0
	21 - 25	175	4	700	2.0	3.0	0	0	0	0	0
	26 & up	25	4	100	2.5	3.5	6	2	150	19	1,900
Inboards	15 - 20	24	4	96	2.5	3.5	6	2	150	19	1,824
	21 - 30	100	5	500	3.0	4.0	9	3	225	28	14,000
	31 - 40	25	6	150	4.0	5.0	14	5	375	47	7,050
	41 - 50	1	6	6	4.5	5.5	16	5	375	47	282
Cruising	21 - 30	75	3	225	5.0	6.0	18	6	450	56	12,600
Sailboats	31 - 40	50	4	200	5.5	6.5	18	6	450	56	11,200
Daysailers	8 - 15	150	1	150	2.0	3.0	0	0	0	0	0
	16 - 20	150	2	300	3.0	4.0	9	3	225	28	8,400
	21 - 25	75	4	300	3.5	4.5	12	4	300	38	11,400
TOTALS		1,200		3,477							68,656

1 Total Users = Avg. # of users/boat X # of boats in fleet

2 Water depth required = Avg. draft + Required clearance under keel

3 Delay for avg. 8 hr. boating day = Tidal delay over 24 hrs ÷ 3

4 Hours foregone/season = Delay for avg. 8 hr. boating day X # of usable boating days/season

5 Days foregone/season = Hours foregone/season ÷ 8

6 User days forgone/season = Days foregone/season x Total users

TABLE 4
FUTURE RECREATIONAL FLEET INVENTORY,
IMMEDIATE ADDITIONS AND 10-YEAR GROWTH
USER ESTIMATE AND TOTAL ANNUAL LEISURE TIME REALIZED

Type of Craft	Length (ft.)	Immediate Additions				10-Year Growth		
		Avg. # of Users/Boat	# of Boats	Days Realized per Season	*User Days Realized/Season	# of Boats	Days Realized per Season	*User Days Realized/Season
Outboards	15-20	2	5	75	750	50	75	7,500
	21 & up	3	5	75	1,125	50	75	11,250
Sterndrives	15-20	2	0	75	0	10	75	1,500
	21-25	4	4	75	1,200	30	75	9,000
	26 & up	4	1	75	300	10	75	3,000
Inboards	15-20	4	1	75	300	10	75	3,000
	21-30	5	4	75	1,500	25	75	9,375
	31-40	6	0	75	450	10	75	4,500
	41-50	6	0	75	450	5	75	2,250
Cruising	21-30	3	2	75	450	20	75	4,500
Sailboats	31 & up	4	1	75	300	10	75	3,000
Daysailers	8-15	1	1	75	75	10	75	750
	16-20	2	5	75	750	50	75	7,500
	21-25	4	6	75	1,800	60	75	18,000
TOTALS			35		9,450	350		85,125**

* User Days Realized/Season = Avg. # Users/Boat x # of Boats x Days Realized per Season

** Future 10-Year Growth fleet realizes 85,125 day x average annual equivalent (0.71586) = 60,938 days

TABLE 5
RECREATIONAL POINT COMPUTATION
BASS RIVER, MA

<u>Criteria</u>	<u>Point Value</u>
Recreation Experience	22
Availability of Opportunity	3
Carrying Capacity	8
Accessibility	15
Environmental Quality	<u>13</u>
TOTAL	61 points

The rating points are converted to dollar value by utilizing Table VIII-3-1 as published in the WRC Principles and Guidelines. From this table, 61 points represents a-unit day value of \$3.70.

Creation of a channel and anchorage areas would also reduce damages sustained by the recreational fleet. Based on responses to questionnaires and discussions with boat operators, it was estimated that an average of \$200 per boat is spent annually on repairs directly related to existing navigation conditions in the river. These damages result from groundings in the channel and anchorage areas, snagged mooring lines, and collisions among boats maneuvering in the river or swinging about their moorings while at anchor.

It is projected that with the implementation of Federal improvements, approximately 40% of these damages would be eliminated. (Factors such as weather conditions and piloting skills cannot be addressed.) By following this methodology, a reduction in damages benefit is computed as follows:
 $(\$200/\text{boat} \times 1,200 \text{ boats} \times 0.40) = \$96,000$

Table 6 summarizes annual benefits to the recreational fleet as assessed.

TABLE 6
RECREATIONAL BENEFITS SUMMARY
EVALUATED PLAN OF IMPROVEMENT

<u>TYPE OF BENEFIT</u>	<u>USER DAYS</u>	(x\$3.70) <u>AVERAGE</u> <u>ANNUAL BENEFIT</u>
1. Leisure Time Saved Existing Fleet	68,656	\$254,000
2. Leisure Time Realized Future Fleet		
- Immediate	8,550	32,000
- 10-year Growth	60,938	225,000
3. Damage Reduction	---	96,000
TOTAL AVERAGE ANNUAL BENEFIT		\$607,000

Commercial Benefits

Benefits to commercial fishing would be derived from the creation of a maintained channel and anchorage areas by providing safer navigation and moorings for existing and newly attracted fishing vessels. A maintained channel would allow for increased fishing time as a result of eliminated tidal delays and hence an increase in daily catches. Additional benefits would also be derived through reduction in damages due to groundings and collisions.

Estimates for increased catch for the existing fleet and additional catch from newly attracted boats were obtained from local commercial fishermen. These quantities represent a composite dockside value for the various species of finfish landed by the commercial fleet.

Further discussions with local commercial fishermen indicate that approximately \$500 per boat is expended annually on repairs to damages attributed to groundings and collisions. It is projected that navigation improvements would eliminate approximately 50% of these damages. As such, the reduction in damages benefit is as follows:

$$(\$500/\text{boat} \times 35 \text{ boats} \times 0.50) = \$8,700$$

Due to the minor role that commercial fishing plays in the Bass River (35 boats vs. 1,200 recreational boats), no further analysis of commercial benefits was performed at this time. Only the major benefits of increased catch and reduction of damages have been addressed.

Table 7 summarizes annual benefits to the commercial fleet as assessed.

TABLE 7
COMMERCIAL BENEFITS SUMMARY
EVALUATED PLAN OF IMPROVEMENT

TYPE OF BENEFIT		
1.	Increased Fish Landings for Existing Fleet	\$ 600
2.	Additional Fish Landings for Future Fleet	26,500
3.	Damage Reduction	8,700
	TOTAL AVERAGE ANNUAL BENEFIT	35,800
	SAY	36,000

Table 8 depicts the total quantified benefits resulting from the evaluated plan of improvement.

TABLE 8
EVALUATED PLAN OF IMPROVEMENT
TOTAL EVALUATED BENEFITS

Recreational Benefits	\$ 607,000
Commercial Benefits	36,000
TOTAL AVERAGE ANNUAL BENEFITS	\$ 646,000

Comparison of Benefits and Costs

A proposed project's contribution to the national economic development is measured by comparing the project's annual benefits and costs as a ratio. If the benefit-cost ratio (BCR) is greater than or equal to 1:1, the project is considered to have a net positive effect on the national economic development.

The BCR for the evaluated plan of improvement is presented below.

	Annual Benefits	Annual Costs	BCR	Net Annual Benefits
Evaluated Plan of Improvement	\$ 643,000	\$191,000	3.4:1	\$ 452,000

Apportionment of Costs

The first cost of construction of the evaluated plan of improvement is apportioned between Federal and non-Federal interests in proportion to commercial and recreational benefits. The first cost of construction for that portion of the project for which benefits are accrued by the commercial fleet would be borne entirely by the Federal Government. The first cost for that portion which accrues benefits to the recreational fleet are apportioned 50 percent Federal and 50 percent non-Federal. Based on first costs for improvements and all quantified benefits

associated with the evaluated plan of improvement, apportionment of costs is 52.8 percent Federal and 47.2 percent non-Federal.

Allocation of Costs

All of the Federal costs of this evaluated plan of improvement would be attributed to construction of the channel and anchorage area.

Federal Responsibilities

Of the first cost of construction, 52.8 percent or \$582,000 would be a Federal responsibility because of the mixed commercial-recreational fleet. All costs of future maintenance, assuming continued justification, availability of funds, and environmental acceptability would also be a Federal responsibility.

Local Responsibilities

Local interests would be required to:

1. Provide a cash contribution toward construction costs, determined in accordance with existing policies for regularly authorized projects, in view of recreational benefits, land enhancement benefits, or similar type special and local benefits expected to accrue. The present basis for cost-sharing in recreational small-boat projects provides that the Federal Government will bear not more than 50 percent of the first cost of general navigation facilities serving recreational traffic. The evaluated plan of improvement results in benefits to both commercial and recreational concerns. Since recreational benefits account for 94.4 percent of the total benefits, the local cash contribution will equal 47.2 percent of the first cost of construction. This amount is presently estimated at \$520,000.

2. Provide, maintain, and operate without cost to the United States an adequate public landing with provisions for the sale of motor fuel, lubricants, and potable water open and available to the use of all on equal terms.

3. Provide without cost to the United States all necessary lands, easements, and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads, and embankments therefor.

4. Hold and save the United States free from damages that may result from construction and maintenance of the project.

5. Accomplish, without cost to the United States, alterations and relocations as required in sewer, water supply, drainage, and other utility facilities.

6. Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary access roads, parking areas, and other needed public use shore facilities open and available to all on equal terms. Only minimum, basic facilities and services are required as part of the project. The actual scope or extent of facilities and services provided over and above the required minimum is a matter of local decision. The manner of financing such facilities and services is a local responsibility.

7. Assume full responsibility for all project costs in excess of the Federal cost limitation of \$2,000,000.

8. Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention and control.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

As the result of my review of the preliminary analyses contained in this report, I find that there is an economically feasible plan for construction of a Federal navigation project in Bass River at Yarmouth and Dennis, Massachusetts. Local interests strongly support such navigation improvement which would relieve the increasingly hazardous navigation conditions encountered during the recreational boating season. The proposed plan of improvement described in this report represents the most economically optimal plan that has been identified. The extent of channel development is dictated by the location of the proposed local shore facilities and existing deepwater portions of the river. The proposed anchorage areas are located in and limited by the only remaining accessible areas available for expansion in the harbor. More detailed analyses will be required before any final recommendation can be made.

Recommendation

In view of the favorable findings of this report, I recommend further detailed study of navigation improvements in Bass River at Yarmouth and Dennis, Massachusetts.

APPENDIX A
PERTINENT CORRESPONDENCE



TOWN OF YARMOUTH

SOUTH YARMOUTH

MASSACHUSETTS 02664

September 27, 1982

BOARDS OF
SELECTMEN
ASSESSORS
HEALTH
EXECUTIVE
SECRETARY

Lt. Colonel Arthur N. Rappaport
Corps of Engineers
Division Engineer
Department of the Army
424 Trapelo Road
Waltham, MA 02254

Re: Bass River Dredging

Dear Colonel Rappaport:

As a result of a meeting between officials from the Town of Yarmouth and representatives from the Army Corps of Engineers on August 26, 1982 the Yarmouth Board of Selectmen would like to formally request that under Section 107 of the 1960 Rivers and Harbors Act, as amended, the Corps of Engineers undertake a navigational project of Bass River to determine the applicability of this program to our river.

Our understanding is that the cost of this initial study will be borne by the Corps of Engineers. We also understand that as the project progresses local funding will be required if the project is to be completed. Our office is prepared to supply you with any assistance you may need to complete this initial phase of the review of Bass River with the potential of possibly having the Corps of Engineers participate in the dredging of the river and subsequently maintaining Bass River as a navigable waterway.

Thank you for your consideration of our request and if we can provide you with any further information please feel free to contact me at the Yarmouth town office, telephone 398-2231.

Sincerely,

Robert C. Lawton, Jr.
Executive Secretary

cc: Charles P. Collins
Richard F. Zeoli

RCL/rd

OCT 4 1982



Town of Dennis
South Dennis, Mass. 02660

Office of
SELECTMEN
394-0901
EXECUTIVE SECRETARY
394-0901
ASSESSORS
394-0903
BOARD OF HEALTH
394-0905

October 14, 1982

Lt. Colonel Arthur N. Rappaport
Division Engineer - COE
424 Trapelo Road
Waltham MA 02254

Dear Colonel Rappaport:

The Town of Dennis formally requests that the U.S. Army Corps of Engineers explore the possibility of a navigational project at Bass River.

I am attaching a similar letter from the Town of Yarmouth, which is also behind such an effort. Dennis will assist you as needed in your studies. We hope that you will participate in this project.

Please call Terry Proctor of my staff at 394-0902 if you have any questions.

Very truly yours,

Allan S. Young
Allan S. Young
Executive Secretary

ASY/sai

cc: Richard F. Zeoli
11 Aunt Edith's Road
South Yarmouth MA 02664

Waterways Committee Chairman
Harbormaster

OCT 20 1982



TOWN OF YARMOUTH

SOUTH YARMOUTH

MASSACHUSETTS 02664

July 8, 1983

BOARDS OF
SELECTMEN
ASSESSORS
HEALTH
EXECUTIVE
SECRETARY

Colonel Carl B. Sciple
U.S. Corps of Engineers
Division Engineer
New England Division
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Sciple:

We received your recent letter concerning the navigation study for Bass River in the Town of Yarmouth and had forwarded copies to the Waterways Committee and Natural Resource Department for their review and comment.

Each of these organizations has favorably recommended the continuation of this study as you outlined in your letter of June 17. The Town of Yarmouth feels strongly that the detailed project report will show the justification for involvement by the federal government in the maintenance of this very important waterway on Cape Cod.

We have also reviewed the eight items of local cooperation which are part of Section 107 of the 1960 River and Harbor Act. The Town of Yarmouth would agree to comply with each of the eight items with the proviso that town meeting action must be taken on all requests for the appropriation of funding. Our understanding is that we will have sufficient time to develop appropriate cost estimates and secure necessary funding at the local level in order to support the project as defined by your representatives at various meetings with town officials.

The town is enthusiastic about the continuation of this study and hope that your recommendation will receive final approval by the Chief of Engineers.

Sincerely,

Robert C. Lawton, Jr.
Executive Secretary

cc: Waterways Committee
MG Richard F. Zeoli

RCL/rd



Town of Dennis
South Dennis, Mass. 02660

Office of
SELECTMEN
394-0901
EXECUTIVE SECRETARY
394-0901
ASSESSORS
394-0903
BOARD OF HEALTH
394-0905

July 13, 1983

Col. Carl B. Sciple
U.S. Corps of Engineers
New England Division
424 Trapelo Road
Waltham MA 02254

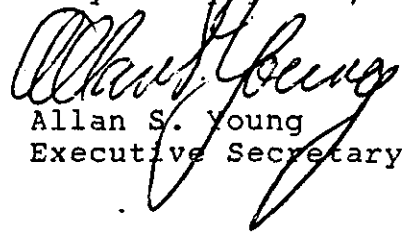
Dear Col. Sciple:

This will acknowledge your letter of June 17, 1983, in which you informed us that further detailed study for proposed navigation improvements in Bass River is warranted.

We are in accord with your recommendation that the preliminary study continue into the Detailed Project Report stage, and are also interested in the Corps proceeding with the investigation.

A review of the eight items of local cooperation, enclosed with your letter, reveals no obstacles to the Town of Dennis' participation in a navigational improvement project, as authorized under Section 107 of the 1960 River and Harbor Act, other than favorable Town Meeting action would be necessary prior to the implementation of any proposed Bass River project.

Very truly yours,


Allan S. Young
Executive Secretary

ASY/sai
Encl.

cc: Robert C. Lawton, Town of Yarmouth
Waterways Commission
Harbormaster John Sheehy
General Zeoli, Yarmouth WW Commission
Board of Selectmen